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PCI-PDISO8

User's Manual

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1.0 INTRODUCTION

1.1 DESCRIPTION

The PCI-PDISO8 has eight isolated input channels and eight relay-output channels. It is made to interface with PCI-compatible computers. The PCI-PDISO8 is used for control and sensing applications where high voltage are to be sensed or controlled.

WARNING!

High voltages will be present on the PCI-PDISO8 board when you have connected high voltage inputs or outputs to the PCI-PDISO8 connector. Use extreme caution! Never handle the PCI-PDISO8 when signals are connected to the board through the connector.

DO NOT REMOVE THE PROTECTIVE PLATES FROM THE PCI-PDISO8.

The inputs are eight individual, optically-isolated (500V) inputs that can be read back as a single byte. The inputs are not polarity sensitive and may be driven by either A.C. (50 - 1000 Hz) or D.C. Each input has a programmable low-pass filter with a time constant of 5 ms (200 Hz).

The outputs are eight, electromechanical relays. Five relays provide Form-C connections and three provide normally-open Form-A connections. The relays are controlled by writing to an 8-bit port. The relay control register can be read back from the same port.

The PCI-PDISO8 is compatible with the optional Universal Library software package.

1.2 ACCESSORIES

The PCI-PDISO8 is a combination digital I/O board with signal conditioning installed. Most accessory boards are intended to provide signal conditioning or easy to access signal termination. In general, the PCI-PDISO8 will not require additional signal conditioning.

We recommend that screw terminal boards not be used with the PCI-PDISO8 if using field voltages greater than 24 Volts. If you use a screw terminal board with high voltage inputs or outputs, you will expose yourself and others to those high voltage signals. We recommend that you construct a safe cable to carry your signals directly from your equipment to the PCI-PDISO8 connector.

2.0 SOFTWARE INSTALLATION

Before you open your computer and install the board, install the InstaCal installation, calibration and test utility included with your board. If you have ordered the Universal Library, InstaCal may be installed from that disk set rather than the InstaCal disk set. Refer to the *Extended Software Installation Manual* for InstaCal installation instructions.

If your PCI board requires manual configuration of switches or jumpers, detailed information regarding these settings can be found below. After configuring your board (if required), install it in your computer as detailed in the Hardware Installation section below and run InstaCal. Once you have restarted your computer and run InstaCal, use InstaCal to verify your installation and switch settings.

3.0 HARDWARE INSTALLATION

The PCI-PDISO8 is completely plug and play. There are no manually configured options. Simply install the board and run InstaCal to verify proper installation.

3.1 INSTALL THE PCI-PDISO8 IN THE COMPUTER

Turn off your computer and remove the cover.

Select an empty PCI slot and insert the PCI-PDISO8 securely into the slot. Make sure it is properly seated in the slot or damage to your PC or board could result.

Replace the cover and turn on your computer.

Run InstaCal to configure your board and test the installation

3.2 AC INPUT FILTER

The inputs are 8 individual, optically isolated (500V) inputs that may be read back as a single byte. The inputs are not polarity sensitive and may be driven by either A.C. (50 - 1000 Hz) or D.C.. Each input has a software enabled/disabled low-pass filter with a time constant of 5 ms (200 Hz).

The input filters are described and set by InstaCal. The filter must be used for A.C. inputs and should be used for almost all D.C. inputs. Unless you have reason to turn off a filter, we recommend it be enabled.

4.0 PROGRAMMING

4.1 ADDRESS MAPPING

The PCI-PDISO8 is easy to program. Three eight bit registers located at the base address (relay output), base+1 (isolated inputs) and base+2 (filter setting) are used to control relays, read back the state of relays, sense inputs or set the filter configuration.

BASE ADDRESS	Relay Output	Read/Write
BASE + 1	Isolated Inputs	Read Only
BASE + 2	Filter Control	Write Only
BASE + 3	Not Used	

Although the PCI-PDISO8 decodes four addresses, only three are used.

The registers are written to and read from as a single 8 bit byte. Each bit controls an output or represents the state of a device or input. Registers are read left to right. The leftmost bit being the most significant bit. Following this format bit 7, of BASE+0 corresponds to relay 7 and bit 0 to relay 0.

To construct a control word, use the following table:

BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

For example, to assemble a control byte to turn on relays 0, 1, 3, 5, and 7:

RELAY	HEX	ON=1	WEIGHT	DECIMAL	ON=1	WEIGHT
RELAY 7	80	1	80	128	1	128
RELAY 6	40	0	0	64	0	0
RELAY 5	20	1	20	32	1	32
RELAY 4	10	0	0	16	0	0
RELAY 3	8	1	8	8	1	8
RELAY 2	4	0	0	4	0	0
RELAY 1	2	1	2	2	1	2
RELAY 0	1	1	1	1	1	1
			AB			171

The isolated inputs are read in this format as well. To disassemble the byte and determine the state of the isolated inputs or the relay read back register, perform the following operation in software:

INPUT/RELAY	HEX	DECIMAL
INPUT 7 / RELAY7	80	128
INPUT 6 / RELAY 6	40	64
INPUT 5 / RELAY 5	20	32
INPUT 4 / RELAY 4	10	16
INPUT 3 / RELAY 3	8	8
INPUT 2 / RELAY 2	4	4
INPUT 1 / RELAY 1	2	2
INPUT 0 / RELAY0	1	1

Perform an AND operation for each bit to see if it is on.. In this example the variable INPBYTE% is the isolated input byte read from BASE+1. This example is in Microsoft Basic though the logic used is easily translated to any programming language.

```
INPBYTE% = INP(BADR+1)
INP7% = INPBYTE% AND &H80
IF INP7% <> 0 THEN ISOINP$ = "ON" ELSE ISOINP$ = "OFF"
```

The code above shows how to determine the state of a particular input. It is this type of logical bit testing that is required to check inputs independently.

4.2 OUTPUT REGISTER

The output register is located at the PCI-PDISO8 base address.

WRITE = CONTROL: Write a byte to the register to control the relays. A one in the relay bit position turns the relay on.

READ = STATUS: Read the status of the relay control register. A one in the relay bit position indicates the relay is on.

ON & OFF for FORM C RELAYS:

On means that FORM C relay common is in contact with the Normally Open contact. Off means that FORM C relay common is in contact with the normally closed contact.

ON & OFF FOR FORM A RELAYS:

On means that FORM A relay common is in contact with the normally open contact. Off means that FORM A common is not in contact with anything.

RELAY	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

4.3 INPUT REGISTER

The isolated input register is located at the PCI-PDISO8 base address + 1.

WRITE = NO FUNCTION

READ = STATUS: Read the status of the isolated inputs. A one in the input bit position indicates that a voltage is present at the input.

INPUT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

4.4 INPUT FILTER CONTROL REGISTER

Register Address: Base + 2

READ: No function

WRITE: Filter selection 1 = Filter enabled, 0 = Filter disabled

The filter number is associated with the INPUT number. For example, if FILTER #1 is enabled, the low pass filter for INPUT 1 is enabled.

FILTER #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

5.0 INTERFACING

This short introduction to the electronics most often needed by digital I/O board users covers the following:

- Connector diagram.
- FORM C relay outputs.
- FORM A relay outputs.
- Isolated inputs.
- Adding a resistor to expand the range of the isolated inputs.
- Voltage dividers.

5.1 CONNECTOR DIAGRAM

The PCI-PDISO8 use a single 37-pin connector. The pin-out is in Figure 5-1 below

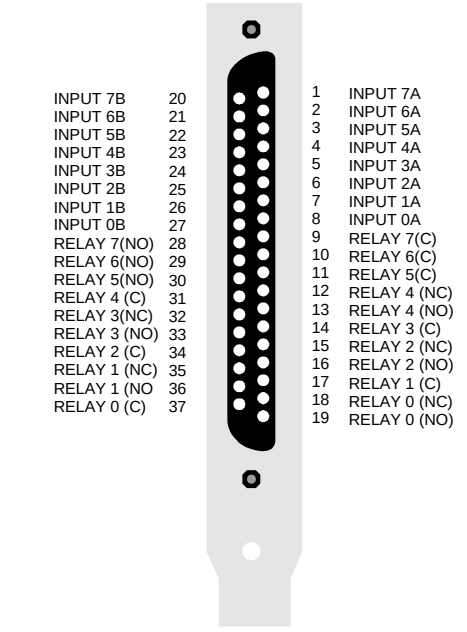

Figure 5-1. 37-Pin Board Connector

WARNING!

High voltages will be present on the PCI-PDISO8 board when you have connected high voltage inputs or outputs to the PCI-PDISO8 connector. Use extreme caution! Never handle the PCI-PDISO8 when signals are connected to the board through the connector.

DO NOT REMOVE THE PROTECTIVE PLATES FROM THE PCI-PDISO8.

5.2 FORM C RELAY OUTPUTS

Figure 5-2 is the schematic for a form C relay, like those connected at RELAY 0 through RELAY 4.

The form C relay has a COMMON, normally open (NO) and normally closed (NC) contact.

When a 0 is written to the output, the common and NC are in contact. When a 1 is written to the output the common and NO are in contact.

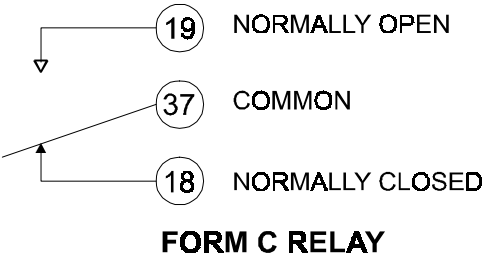

Figure 5-2. Form C Relay (0) Contacts

5.3 FORM A RELAY OUTPUTS

Shown here is the schematic for a form A relay, like those connected at RELAY 5 through RELAY 7.

The form A relay has a COMMON and a normally open (NO) contact.

When a 0 is written to the output, the common and NO are NOT in contact. When a 1 is written to the output the common and NO are in contact.

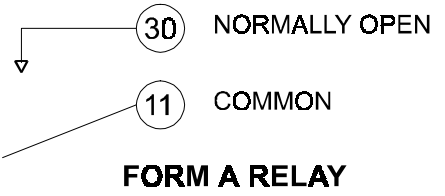

Figure 5-3. Form A Relay (5) Contacts

The form A and form C relays on the PCI-PDISO8 are the same type. Only the connections to the relay poles differ.

5.4 ISOLATED INPUTS

There are eight isolated input channels. The schematic of a single channel is shown in Figure 5-4.

The signals are routed through a bridge rectifier so that the inputs are not polarity sensitive.

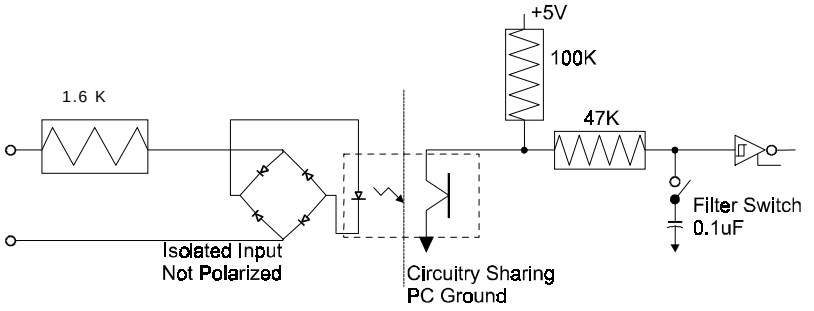

Figure 5-4. Isolated Input Schematic- Simplified

5.5 EXTENDING THE INPUT RANGE

It is possible to extend the input range beyond the 5-28V specified by adding an external resistor. Figure 5-5 shows the resistor and the equations used to calculate resistor values for a given Vin.

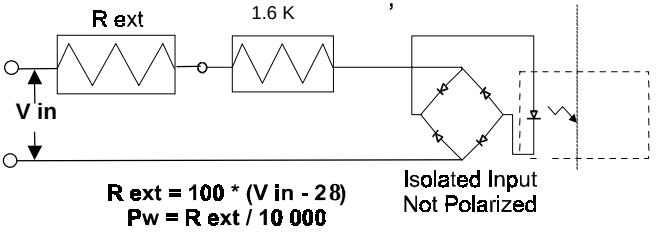

Figure 5-5. Input Range-Extending Resistor

5.6 VOLTAGE DIVIDERS

An alternative method of measuring a signal which varies over a range greater than the input range of a digital input, is to use a voltage divider. When correctly designed, it can drop the voltage of the input signal to a safe level the digital input can accept.

In a voltage divider, the voltage across one resistor in a series circuit is proportional to the total resistance divided by the one resistor (see formula below).

The object in a voltage divider is to choose two resistors having the proportions of the maximum voltage of the input signal to the maximum allowed input voltage.

The formula for attenuation is:

$$\text{Attenuation} = \frac{R1 + R2}{R2}$$

$$2 = \frac{10K + 10K}{10K}$$

For example, if the signal varies between 0 and 20 volts and you wish to measure that with an analog input with a full scale range of 0 to 10 volts, the attenuation (A) is 2:1 or just 2.

$$R1 = (A-1) \times R2$$

For a given attenuation, pick a resistor and call it R2, the use this formula to calculate R1.

Digital inputs often require the use of voltage dividers. For example, if you wish to measure a digital signal that is at 0 volts when off and 24 volts when on, you cannot connect that directly to a digital input. The voltage must be dropped to 5 volts max when on. The attenuation is 24:5 or 4.8.

Using the equation above, if R2 is 1K, R1 = (4.8–1) x 1000 = 3.8K.

Remember that a TTL input is 'on' when the input voltage is greater than 2.5 volts.

NOTE

The resistors, R1 and R2, are going to dissipate power in the divider circuit according to the equation $W = I^2 \times R$; (Current (I) = Voltage/Resistance). The higher the value of the resistance (R1 + R2), the less power dissipated by the divider circuit. Here is a simple rule:

For attenuation of <5:1, no resistor should be less than 10K.

For attenuation of > 5:1, no resistor should be less than 1K.

6.0 SPECIFICATIONS

Power consumption

+5V	
All relays off	0.4A typical
All relays on	1.0A typical

Relay Specifications

Number	8
Contact Configuration	5 form C, RELAY 0 to RELAY 4 3 form A, RELAY 5 to RELAY 7
Contact Rating	6A @ 120VAC or 28VDC resistive
Contact Type	Gold-overlayed silver
Contact Resistance	100 milliohms max
Operate Time	20 milliseconds
Release Time	10 milliseconds max
Vibration	10 to 55 Hz (Dual amplitude 1.5mm)
Shock	10G (11 milliseconds)
Dielectric Isolation	500V (1 minute)
Life Expectancy	10 milliohm mechanical operations, min

Isolated Inputs

Number	8
Voltage Range	
DC	5 to 28V (Not TTL compatible)
AC	5 to 28V (50 to 1000 Hz)
Isolation	500V
Resistance	1.6k Ohms min
Response	
w/o filter	20 µs
w/ filter	5 ms
Filters	
Time constant	5 ms (200 Hz)
Filter control	Each input individually programmable
Power-up /reset	Filters off

Environmental

Operating temperature range	0 to 70°C
Storage temperature range	–40 to 100°C
Humidity	0 to 90% non-condensing

EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product:

PCI-PDISO8	High output digital I/O board
Part Number	Description

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

Carl Haapaoja, Director of Quality Assurance